SCIENCE

VOL. LXXI — FRIDAY, MARCH 7, 1930 — No. 1836

The American Association for the Advancement of Science:
The Relation of Anthropology to Indian and Immigrant Affairs: DR. FAY-COOPER COLE 249

The Gray Herbarium Card Index: PROFESSOR B. L. ROBINSON and LESLEY C. WILCOX 253

Obituary:
John Robert Benton; Recent Deaths; Memorials 256

Scientific Events:
Agriculture in England; The Charles Lathrop Pack Fellowships in Forestry; Appropriations for Grants-in-Aid by the National Research Council; The Atlanta Meeting of the American Chemical Society 257

Scientific Notes and News 260

Discussion:
The Etiology of the Disease Psittacosis: DR. CHARLES KRUMWIEDE, MARY MCGRATH and CAROLYN OLDENBUSCH. *Bacterium granulosis and Trachoma of an Urban White Population:* DR. PETER K. OLITSKY and DR. JOSEPH R. TYLER. *Gas in Collodion Sacs Immersed in Flowing Tap Water:* DR. P. L. K. GROSS and DR. LOUIS S. KASSEL. *History of the Discovery of Periodic Reversal of Heart-beat in Insects:* DR. JOHN H. GEROULD. *The Chemical Constitution of Pectinatella:* DR. WITHROW MORSE 262

Reports:
The Teaching of Hydrobiology and Aquiculture in American Universities: PROFESSOR JAMES G. NEEDHAM 265

Scientific Apparatus and Laboratory Methods:
A Microcinematographic Apparatus for the Owner of 16-MM Motion Picture Camera: DR. HEINZ ROSENBERGER 266

Special Articles:
"Auximones" and the Stimulation of Lemna by Organic Matter: DR. NORMAN ASHWELL CLARK. *Occurrence of Germanium and Arsenic in Meteorites:* PROFESSOR JACOB PAPISH and ZAIDA M. HANFORD 268

Science News x

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. — Garrison, N. Y.

Annual Subscription, $6.00 — Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE RELATION OF ANTHROPOLOGY TO INDIAN AND IMMIGRANT AFFAIRS[1]

By Dr. FAY-COOPER COLE

CHAIRMAN, DIVISION OF ANTHROPOLOGY AND PSYCHOLOGY NATIONAL RESEARCH COUNCIL

FORTY-THREE years ago the Bureau of American Ethnology was formed to collect all the data possible concerning the surviving Indians in various parts of our country. Since that time, departments of anthropology in various universities have been turning out highly trained men who have devoted years to intensive study of the American Indian. Studies have been made of his physical type, his susceptibility to disease and the effects of race crossing, as well as of the development of his diverse cultures from earliest times to the present. The Bureau of American Ethnology alone has issued over 180 monographs and bulletins dealing with the American Indian and his culture, while the publications of other institutions would easily double that number.

[1] Address of the retiring vice-president and chairman of Section H—Anthropology, American Association for the Advancement of Science, Des Moines, December 30, 1929.

With such a mine of information at the disposal of those who have to deal with our aborigines, we should have the most enlightened policy of any nation in the world. What are the facts? In searching the records of Congress which deal with Indian affairs, there is little evidence that that body realizes it has a great research organization at its disposal. A scrutiny of the boards of Indian commissioners in recent years reveals the names of few men who are recognized as authorities on Indian life and custom, while the administration of the Indian Office has often been entrusted to men ignorant of, or indifferent to, Indian customs. Occasionally men of highest ideals have been placed in positions of authority, but they have found themselves overwhelmed with advice from those having special interests in the Indian.

One group urges that we break down the old religion and customs as rapidly as possible; and to

bring this about would forbid the old dances and celebrations, would break up the reservations, would allot the land and force the Indian to "swim or sink," believing that necessity will force him into American life.

Another group exalts the life of "the noble Red Man," and would leave him unchanged, forgetting that the conditions which made the old life possible have been, for the most part, destroyed.

Between those who would perpetuate the reservations and those who would abolish them, between those who would found more Indian schools and those who would put all the children into the public schools, between those who would make the Indian subject to state laws and local courts and those who would judge his crimes according to tribal law—it is no wonder that the newcomer in the field is in a daze; and by the time he begins to learn something of actual needs and conditions he finds a new administration in power, and himself displaced.

Little wonder then that our Indian service lacks a well-trained personnel and that it has been the subject of severe criticism. Little wonder that the Indian has come to look with suspicion on every move which is made for his "betterment."

But it is not the Indian service alone which is groping in the dark for a solution of the Indian problem. A few weeks ago the speaker attended a conference on the Indian. At this session were men and women representing various missionary boards, the Indian Rights Association, the Indian service and similar organizations. A carefully arranged program, evidently intended to bring out the interests of all groups represented, resulted in a series of papers on individual or local problems or discussions of the Indian problem in the light of a single field. A few of the speakers appeared to have a wide grasp of the situation, but it was apparent from the discussion which followed that their excellent presentations made little impression.

It is easy to criticize. It is easy to point out the shortcomings of others. But we anthropologists must realize that something is radically wrong with us if, after forty years of intensive research and the publication of numerous books, we have made so little impression on Congress, on the Indian service, on missionary boards and other Indian workers.

Let us take stock for a moment and see what is wrong. Is it in the training of the workers? Have the studies been shown to be inaccurate or untrustworthy? Has there been any suspicion that we are serving special interests? I think not. Our studies are accepted as being accurate and thoroughly objective; but right here may lie our chief weakness. Not long ago a woman from another field complained that anthropology had succeeded in becoming objective, but in the attempt had lost its soul. Perhaps she is right. We have been so intent on gathering and recording facts that we have had little time to generalize, and when we have generalized it has been along the lines of scientific interest rather than those of practical, every-day life.

We have demonstrated to the scientist the regional character of culture, the dynamics of cultural growth, the effects of environment, of diffusion and of convergence; but we have not been equally successful with the layman. In other words, we have failed to sell our goods to the people who are meeting the Indian problem at first hand.

Is this inevitable? Is it impossible to make anthropological investigations of value to the government, to the missionary and to those who wish to have economic relations with the less advanced peoples?

When America entered the Philippines, the administration of the Interior Department of the islands was given to the Honorable Dean C. Worcester, a man who believed that if you wished to be successful in ruling a people, you must know their background, their social, economic and religious life. Almost the first step taken toward gaining this information was the founding of the Bureau of Non-Christian Tribes, and an ethnological survey. A real attempt was made to understand the people of a region before we extended our government to them, and it was sought to make our laws conform as closely as possible to the customary law of the region. The result was the establishment of friendly relations with nearly all the pagan tribes and a minimum of bloodshed.

Our neighbors to the north of the Philippines, who sought to impose their rule on a similar people, but without this preparation, have met with bitter opposition and are now waging a war of extermination against the hill tribes. In the island of Sumatra the Dutch sought to extend their rule into the Padang Islands, the country of the Menangkabau. They sought to follow the same methods as they had pursued in Java; namely, that of strengthening one of the petty chiefs and through him ruling the country. But the scheme failed, and for two hundred years Holland made little headway. Finally, following a serious rebellion in 1907, they decided to try a different system. A group of anthropologists was sent to the region, instructed to gain all possible information concerning the life and beliefs of the people, and especially to learn the *Adat,* or customary law. I have not time here to cite the situation which they found more than to indicate that, despite the fact that the Menangkabau are closely related physically and linguistically to the people of Java and live in adjacent territory, they have a system of descent, of gov-

ernment and ownership of property so radically different from that of Java that no single system of control could be expected to cope successfully with both.

By 1911 the Dutch had learned enough of the situation to attempt again to penetrate the country, this time through friendly advances rather than through force; and when I was in the country in 1922 and 1923, I found a half dozen Dutch officers and 100 Ambionise soldiers controlling without difficulty more than a million and a half of the tribesmen.

In the northern part of this same island, the Rhennish mission undertook the work of conversion of the Battak, a powerful cannibal tribe which had offered constant opposition to the white man. Under wise leadership, these missionaries sought first to learn the native life, then to modify it so as to remove the most savage customs yet disturb the old as little as possible. The motto often quoted to me was: "Destroy only when you have something with which to replace." There the work was so successful that they made more than 100,000 converts among one of the most savage tribes in all Malaysia. Then came the World War. Many of the missionaries were withdrawn, and for months, in some places for years, the converts were left without guidance. Yet we found them conducting their services and continuing the new religion without let-up. The missionaries had succeeded in so merging the old and the new that there was no question of reversion to old conditions.

On a nearby island we found quite the opposite situation. Here the missionaries were of a different mind. Their motto was: "Destroy the old so as to establish the new." Old customs were derided; the old faith was shattered, instead of being incorporated; the power of the chieftains was broken, and the schools sought to instruct the children along European lines. Then came the war and the withdrawal of the missionaries. With old customs and faith shattered and with the old control gone and the new teachers removed, a most chaotic condition prevailed. Ashamed to return to the old life and yet not fitted to the new, the people drifted spiritually and economically into a hopeless condition, and at the time of our visit presented only the shattered remnants of a culture which a few years before was recognized as one of the most advanced of primitive civilizations.

Here we have presented a conspicuous success and a dismal failure, and the reasons are evident. You can not rule a people, you can not adapt a new faith or a new culture to a people, unless you know their background. You can not build a successful, self-respecting society on an inferiority complex.

I should like to cite one more instance. There has recently come to my attention the work of the British schools in the former German territory north of Lake Tanganyika in Africa. Here the aim is to establish an educational system based on native custom, yet which will introduce such modifications as will fit the individual for the social and economic changes which follow contact with Europeans. The first six months were given over to an anthropological survey of three closely related tribes. Friendships were established, the cooperation of chiefs and elders secured, while the knowledge of local institutions made it possible to merge old and new without in any wise destroying the self-respect of the natives. The first native institution to be employed was that of *wigendo* or the calling of boys and young men to the courts. For ages past it has been the right and duty of the chiefs to summon a large number of youths to court where they served while they were being instructed in tribal lore and crafts. The second institution was the counsel of elders. In each district there is an elder who is authority on native tradition. It is his duty to guide the ruler and his people, and to rebuke those who err from custom. With the support of the chiefs, the youths are summoned and the elders join with the white teachers as instructors. They teach the traditions of the tribe, assist in maintaining discipline and also act as counsel to discuss and settle difficulties.

By using these old institutions, a link has been forged between the old and the new. The cooperation of the older generation has been secured, and the pride of the boys in their race and customs has been fostered. Instruction is planned so that it continues the past interests, yet adds to them. The boys are taught improvements in hygiene, in standards of life; they are given instruction in agriculture and animal care in addition to normal academic instruction. However, care is taken not to make the break too great or too sudden. They begin with simple native methods and advance as rapidly as possible. They build houses and school buildings, following native types and using native materials, but adding such modern improvements and conveniences as are available or can be produced locally. Too often natives are instructed in the use of materials and devices which are beyond their means when they leave school, but all the advances learned in these schools are available when they return home, and thus they are able to introduce new aids and comforts into the native villages. The aim has been to build on those aspects of native life that are important and enduring, and from these to develop new forms of activity that will fit for contact with Europe, yet will preserve pride of race and tribe. The experiment is still in the early stages, but the full cooperation of the

chiefs has been secured, and the schools have constantly grown.

The Dutch in the Indies, the British in Africa and Malaysia, have learned that the only successful way to deal with the natives is to have the administrators versed in native lore and custom and to govern as closely as possible in accordance with the established code. We have found the same to be true in the Philippines, and it is to be hoped that we will ultimately realize that this will apply equally well to our Indian problem.

I have just said "Indian problem" but there is no such thing. Rather, we have a series of problems. We can not correctly speak of the American Indian, if by this we mean to imply that economically, culturally or religiously he is everywhere the same, or even similar. Every student of ethnology knows that there are several well-defined culture areas north of Mexico, and within these there are many tribal and local variations. The instruction and guidance which will fit the sedentary Pueblo Indian has at present little practical value or interest for his seminomadic neighbors. It is useless to teach the Navajo how to build good houses without attempting to reach and modify the belief that a dwelling must be destroyed or abandoned upon the death of a member of the family. It is neither wise nor right to deny the Indian the privilege of conducting a native dance by means of which he hopes to influence the powers which control the rain or which produce fertility. This has often been advocated, but the sponsors should realize that by so doing they not only kindle native resentment, but having forced the rites into secret practices have really strengthened their hold on the native mind.

It is only by following such a policy as that of the British in Africa which I have cited that we can slowly shape and modify native life and customs. It is, of course, true that in some regions the native life is shattered, the customs and beliefs have largely lost their hold and the Indians are living much like white men. It is likewise true that in many such regions we find the greatest disorganization; the native has been taught to despise the old, yet he is not fully accepted into the new, and like a raft in a storm he is carried hither and yon without aim or purpose. Some individuals succeed in spite of such handicaps, but the majority sink below the level of their white neighbors and become liabilities rather than assets.

American anthropology has proved beyond a doubt that the American Indian is not an inferior being, either physically or mentally. A late arrival on this continent, he was pioneering while Europe was far advanced toward civilization. Without domestic animals other than the dog and turkey, he steadily advanced in culture until in Middle America he achieved a real civilization. He constructed great cities; he built pyramids and temples which rival those of Egypt and Greece; he invented a written language and was far advanced in astronomy and mathematics; he developed agriculture and gave to us a large number of the domestic plants which now form the basis of our economic life. I might cite his metal working, wood-carving, weaving, pottery and other crafts, but enough has been said to indicate that potentially the Indian is capable of great advance, if given the proper guidance. Every monograph on Indian life will show many elements which should be preserved and which can be used in building for the future. A great amount of material has been collected; it now becomes our duty to make it available to those who can apply it.

It should be our aim to lend helpful cooperation to all agencies working in behalf of the American Indians, and this we can do without sacrificing the high scientific standards which we have established.

There is still another problem of great importance to our nation in which anthropology should make contributions of great importance. That is the immigrant problem. Until a few years ago the majority of the newcomers to this country were drawn from northern Europe, and the similarities of speech and custom made it easy for them to merge into our population. But with the influx of southern Europeans we suddenly found that we had to absorb peoples with backgrounds very different from our own. We did not understand them and they did not understand us, and the result has been the settlement of such peoples in compact communities in which they perpetuate old world customs and feuds, and their participation in American life has been long delayed.

The same situation is rapidly developing with the Mexican who is coming to us in ever-increasing numbers. That anthropology can give us an understanding of these peoples is conclusively shown by the background studies carried on in Mexico and Sicily. In these studies the investigators have lived for months in regions from which we have been drawing immigrants and have sought to gain a clear insight into the social, economic and mental life. With this information available we are able to understand what happens when known cultures meet; we are able to direct the newcomers and aid in their absorption into our life. Such information at once becomes available to the economist, sociologist, political scientist, welfare worker and others who are interested in social studies.

I have given my topic as "The Relation of Anthropology to Indian and Immigrant Affairs," but I might have extended the discussion to child development, to

problems of growth and dentition, to race mixture, to criminology and to many other fields closely linked with our investigations.

Anthropology has contributed much to our knowledge of man and his culture in all ages; it must now give more attention to the application of this information to present-day problems.

We must sell our goods. We must convince the practical workers in these fields that we have something they need for the solution of their problems. We can aid the government officer, the social worker, the missionary, the teacher, as well as our fellow scientists. We can have the same satisfaction in seeing our carefully gathered facts put to practical use as the worker in pure science has in watching his discoveries applied to industry.

THE GRAY HERBARIUM CARD INDEX

By Professor B. L. ROBINSON and LESLEY C. WILCOX

GRAY HERBARIUM, HARVARD UNIVERSITY

FOR twenty-six years the staff of the Gray Herbarium has compiled and published a card catalogue of the newly described and renamed plants of America. The work was undertaken in order to continue a similar card index which had been begun and carried through about ten years by Miss Josephine A. Clark, who at the time was librarian of the U. S. Department of Agriculture. The history of the undertaking has never been recorded in print and may be summarized as follows:

An experimental study preliminary to the enterprise was the publication by Miss Clark of a list of such phanerogams and vascular cryptogams of the North American continent as had been newly published or renamed during the year 1891. This list was compiled by Miss Clark under the supervision of the late Dr. J. N. Rose, and appeared in the Contributions from the United States National Herbarium i. 151–188 (issued September 20, 1892). At that time the "Index Kewensis" had not yet appeared and the importance of Miss Clark's list was immediately evident. It was welcomed as the first of a series likely to be continued each year. However, for several excellent reasons it was decided that the catalogue would have much greater convenience and utility if it could be issued at more frequent intervals and be printed on cards so that the successive parts could be readily arranged in a single alphabetic sequence or, at the wish of the subscriber, be separated into systematic or geographic groups. It was also felt that it should include the new plants, not merely of North America, but of the whole American continent and the adjacent islands.

After due consideration and with the encouragement of the botanists at the Department of Agriculture and at several other centers of botanical activity, Miss Clark undertook such a card catalogue. Her first expectation had been to restrict it to the higher plants in the manner of her first list, but she was urged by the cryptogamists of the department, especially by the plant pathologists, to include also the cellular cryptogams. This she did, it is believed, rather reluctantly, realizing the great difficulties involved.

Miss Clark's catalogue was issued in twenty instalments beginning early in 1894 and continuing to 1903. These issues ranged from 920 to 2,144 cards each. The catalogue was printed on cards of the then current library size, namely, 5 x 2 inches, a form which it has never seemed desirable to change. The plan of the work was to have (1) a card for each newly characterized American genus, species, subspecies, variety or other named form, the scientific name appearing in full and being followed by the name or recognized abbreviation of the name of the author, together with a bibliographical reference to the place of publication and a very brief statement of range, (2) a card for each scientifically renamed American plant with similar bibliographical reference to the place in which the new name or combination was published, followed by explanatory synonymy, (3) a cross-reference card indicating in each case of transfer the name-bringing synonym, followed by the new name, (4) a blue card (long since discontinued) of the same size indicating the title of each work indexed, (5) reprinted cards when needful to supplement previous synonymy and references and (6) correction cards (issued without charge) to emend any detected errors.

Very soon after the Card Index had been begun, the first part of the great "Index Kewensis" appeared, a work which was to list the genera and species of phanerogams of the world published up to the end of 1885. It then became one of the primary purposes of the Card Index to furnish American botanists with an effective supplement to this more universal work. Therefore, the attempt was made to carry the Card Index back to the beginning of 1886, an undertaking which, with all practicable endeavor, it has not been possible entirely to accomplish.

Miss Clark was much aided by the collaboration of Mrs. Alice F. Stevens and, in the later part of her work, she employed also in the indexing of certain

works the assistance of Miss Mary A. Day, who was then the librarian of the Gray Herbarium. By 1903, however, Miss Clark's duties as librarian of the Department of Agriculture had so increased that she desired release from further care of the Card Index and most generously handed it over with its good-will and subscription list to the Gray Herbarium, where its importance was particularly appreciated and where Miss Day, already trained in its methods of work, could carry it forward consistently and effectively.

When turned over to the Gray Herbarium, the Card Index contained 27,999 cards. Miss Day, from 1904 until the middle of 1923, did most of the indexing, though she had from time to time aid from other members of the Gray Herbarium staff, especially from Miss Edith M. Vincent, who through many years assisted her. In 1923, when, toward the close of her life, her work on the Card Index was given up by Miss Day, the number of cards had been advanced to about 170,000. Since the autumn of 1923, the Card Index has been conducted by Miss Lesley Chillingsworth Brown (now Mrs. Lesley C. Wilcox), appointed bibliographer of the Gray Herbarium largely for this complicated duty. Mrs. Wilcox has had aid in her work, especially in the assembling of the literature to be indexed, in the interpretation of doubtful references and in critical verification, from nearly all the other members of the Gray Herbarium staff, as the time at their disposal or their special acquaintance with difficult groups rendered their services available or particularly needful, Dr. I. M. Johnston having given special aid on the side of the now copious Spanish- and Portuguese-American botanical literatures. At present the Card Index has run to 124 quarterly issues, together including 199,011 cards.

From its beginning until 1909 the cards were sold at the uniform rate of $15 per thousand. Since that time, on account of the very greatly increased cost of printing, it has been necessary to raise the price to $22.50 per thousand. It may be said at this point that although the sale of sets to the subscribers has somewhat more than defrayed the cost of printing, the returns have never fully covered the expenses of compilation, not to mention the great amount of salaried time employed in the critical verification. As the index has thus been sold at less than cost, it naturally has not been feasible to reduce its price.

To date no less than 375 botanical journals and scientific serials have been indexed, as well as about 350 monographs which have not appeared in serial form. The catalogue has covered works in no less than fifteen languages. So very numerous have been the individual papers which have received attention that it has not been found feasible to continue Miss Clark's system of issuing the blue cards to record their titles.

The largest single lacuna in the work of the index arises from its inability to cover to date a considerable part of Dr. Otto Kuntze's "Revisio Generum." In this work the often rather arbitrary and artificial renaming of plants created thousands of new names and new combinations, many of them being applicable only under the rules individually devised by Dr. Kuntze and sanctioned by no widely accepted code. To have introduced these names and combinations at any one time into the Card Index would have so extended the issues as to have rendered their cost prohibitive to subscribers. It has therefore been thought best to introduce these names gradually, only a hundred or so at a time, when the issues were not otherwise crowded. In this manner these competing names, at least so far as the phanerogams and vascular cryptogams are concerned, can ultimately be recorded and in a manner less burdensome to the subscribers.

It long ago became evident that the indexing of the cellular cryptogams involved well-nigh insurmountable difficulties. Notwithstanding the best endeavors which could be put forth the cryptogamic indexing fell very much behind the completeness and efficiency of the phanerogamic, and at the end of 1927 it was found impracticable to continue it. The reasons for this change may be briefly stated as follows. Cryptogamic botany for many decades has been growing highly specialized. Its groups are so unlike in their nature as to require very different methods of investigation. From the standpoint of research it may be said that cryptogamists, as such, have ceased to exist. They have been replaced by specialists who restrict their activities to particular groups—to the mosses, hepatics, algae, the lichens, fleshy fungi or pathogenetic fungi. As a result such specialists have little experience or interest in the general bibliography of the cryptogams, and consequently it was found impossible to secure collaboration in this undertaking without subdividing the work beyond practical limits. Inquiry of the subscribers showed that the majority of the establishments which were purchasing the Card Index were using it primarily, if not exclusively, for its information relative to the phanerogams and vascular cryptogams. No one of these subscribers showed much interest in incurring the very large expense which would have been entailed if the index were brought to date on the cryptogamic side. Not only would this have very greatly increased the cost of the index to subscribers, but it would, so to speak, have inconveniently diluted it and rather lessened its convenience for those consulting it chiefly in connection with phanerogamic and pteridophytic work.

Further inquiry developed the fact that cryptogamic specialists had little interest in the index because many of them developed for their own purposes more effective special lists of the particular groups on which they are working.

Finally it was found that much of the newer publication upon the cellular cryptogams runs to a complexity far beyond the powers of accurate interpretation on the part of any indexer who is not particularly acquainted with the group concerned.

For these very cogent reasons it was felt that the Card Index could neither satisfactorily bring to date its indexing of the cellular cryptogams nor run the risk of proving misleading by any inadequate presentation of these groups. The change was made reluctantly and with the hope that the botanists occupied with the cellular cryptogams may effect in their field some similar undertaking which will far better meet their needs.

The cost of the index to each subscribing establishment which has kept its subscription continuous from the beginning has been $3,389.62. The index is now being regularly taken by seventeen establishments,[1] five of them being governmental, and two being in Europe. It will be readily understood that the work is of a kind which proves exceedingly useful in connection with a large botanical library and at establishments where taxonomic research on American plants is in progress.

The majority of American botanical investigators confine their researches to American plants, and for them this index possesses several elements of particular convenience; among these, promptness of issue is one of the most important. A very large part of the publications which include American plant-novelties are received and indexed within three months of their publication, and the issue of the Card Index which contains reference to such publications comes out, as a rule, within six months of the appearance of the papers covered. The index has the further advantage that it covers not merely the flowering plants, but the ferns and their allies as well, which, of course, is not true of the "Index Kewensis" and its admirable supplements. The Card Index lists not merely the genera and species, in the manner of the "Index Kewensis," but also subspecies, varieties and named forms. The cross-reference cards in the Card Index are also a source of much convenience and quick information, since they indicate each old name which has suffered replacement or transfer. Finally, the Card Index has the inestimable advantage that it permits the ready arrangement of all these names in a single alphabetic sequence.

Unhappily the work is of a nature in which it was quite impossible to carry an edition which would permit much reserve for the future. Some of the early issues were exhausted many years ago. About two thirds of the whole is still available in a very few sets.

For some years the issues have run rather evenly to about 1,200–1,250 cards per quarterly issue. This brings the average cost of the index for subscribers to about $110 per year.

Even those recent subscribers who have not attempted to acquire the back issues have given assurance that they were finding the index very helpful in drawing to their attention papers which had not come to their notice, but were significant to their work.

No one who has not actually engaged in a bibliographical undertaking of this nature would suppose that new species could be hidden in places so obscure as those in which they are sometimes found, as, for instance, in school programs, college dailies, sporting and outing journals, town and county histories, etc.

Before closing this account we wish to express very cordial appreciation of the volunteer assistance which has from time to time been sent by botanists interested in the completeness of the Card Index; special aid in this matter has come from the U. S. National Herbarium, the Department of Agriculture, New York Botanical Garden, Field Museum, Missouri Botanical Garden and from the great herbaria at Berkeley and Stanford University in California.

In view of the fact that the Gray Herbarium, without any educational grant or other subvention, has been carrying for twenty-six years and is continuing this widely useful work at the sacrifice of much time and at some financial loss, it seems justified in urgently requesting cooperation on the part of the authors and editors who publish work including new American plants. Such aid may appropriately take two forms. In the first place the indexing can be accomplished much more easily and completely if authors take proper pains to indicate clearly all new plant-names so that these may be caught by the bibliographer without undue trouble, many such names and combinations having been in the past so obscurely put forth that their actual novelty can be ascertained only by prolonged researches into synonymy and previous literature. In the second place authors of new American plants or new names for American plants, at least among the phanerogams and vascular cryptogams,

[1] The list of present subscribers includes: Arnold Arboretum; Botanical Museum at Berlin-Dahlem; Carnegie Museum; Field Museum of Natural History; Gray Herbarium; John Crerar Library; Missouri Botanical Garden; New York Botanical Garden; Royal Botanic Gardens, Kew; Stanford University; Library of the U. S. Department of Agriculture; Department of Botany of the U. S. National Museum; University of California at Berkeley; University of California at Los Angeles; University of Minnesota; University of Wisconsin, and Victoria Museum, Ottawa.

will confer a great favor by sending copies of their papers to the Gray Herbarium as soon after publication as possible. The result will be an early indexing of the novelties and incidentally a wider publicity for the papers themselves, thus adding much to their usefulness and prompt scientific recognition. It may be pointed out that such cooperation on the part of individual authors will contribute effectively to their mutual convenience.

A few words may here be said on the care and use of the Card Index. When received by subscribers each issue has its cards in alphabetic order, but then has to be incorporated into the index as a whole. This process is one which requires close attention, for not only should the alphabetizing be exact, but much care should be taken to remove from the index all those cards which are being replaced. These are of two kinds: (1) those which have been found defective and are to be replaced by the cards definitely labeled "corrected reprint," (2) those cards which are to be replaced by others furnishing not merely the same information, but one or more added synonymic cross-references.

To keep the index as accurate, clear and compact as possible, it is highly essential to remove promptly and permanently these cards which have been corrected or superseded. So rapid is the growth of synonymy and so frequently do transfers occur that the cards which have to be reprinted to show these matters become very numerous. The removal of cards replaced for these causes reduces the bulk of the index as a whole by about 9 per cent., an element to be taken into account in its compactness, convenience and the lessened drawer space needful for its setting up.

To insure against slip or error, it is wise to preserve, in a separate place and at least for some years, all cards thus taken out. If stored in alphabetic sequence these removed cards may at any time be subsequently consulted if question arises whether some of them may not have been taken out accidentally and by error.

In any form of revisional or monographic work upon a group of plants, the index is immediately found to be invaluable. It not only serves to indicate the recently published species of the group, but, what is accomplished by no other single source of information, a list of the newly published propositions in the subspecific categories. Furthermore, it furnishes immediate clues to the recent literature dealing with the groups themselves. In classificatory papers very few of extent or significance fail to put forth some description of plant novelties or some correction of plant names. The Card Index, by recording such novelties and transfers, thus becomes, incidentally, an admirable subject index for the systematic botanist and covers a high percentage of the literature important to his activities.

Issues 1 to 55 (1894–1912) were printed by H. N. Patterson, of Oquawka, Illinois, at that time well known as a skilful printer of botanical labels, lists, etc. From issue 56 to date the Card Index has been printed, alphabetized and mailed by the Library Bureau, Cambridge, Massachusetts.

Any communications regarding the Card Index should be addressed to The Bibliographer, Gray Herbarium, Cambridge, Mass.

OBITUARY

JOHN ROBERT BENTON

DR. JOHN R. BENTON, dean of the College of Engineering of the University of Florida for nineteen years and a member of the faculty since the establishment of the institution at Gainesville in 1905, died on January 8, after an illness of only five days. He was fifty-three years of age. Death was due to pneumonia growing out of an attack of influenza.

Dean Benton was a leader in the engineering field in the United States. He was the author of twenty-four books, the last of which, "An Introductory Textbook on Electrical Engineering," was published in 1928. Born at Concord, N. H., his education was received at Trinity College and the University of Chicago, and abroad at the University of Göttingen and the University of Berlin. He received his B.S. and B.A. degrees from Trinity in 1897 and 1898 and his Ph.D. degree at the University of Göttingen in 1900.

Dr. Benton was a member of Phi Beta Kappa, Phi Kappa Phi, Sigma Xi and Theta Chi fraternities, and of many scientific and professional societies and associations, including the American Physical Society, the American Institute of Electrical Engineers, American Association for the Advancement of Science, the American Association of Engineers, the Society for Promotion of Engineering Education, the National Electric Light Association and the Florida Engineering Society. The Benton Engineering Society is an organization of University of Florida engineering students.

Prior to going to the University of Florida, Dr. Benton occupied positions on the engineering faculties of Princeton and Cornell Universities.

He was one of the most beloved citizens of Gainesville, having been prominently identified with the city's progress during his years of residence there.

RECENT DEATHS

PROFESSOR HECTOR J. HUGHES, dean since 1920 of the Harvard University School of Engineering, died on March 1, at the age of fifty-nine years.

MARY WHITON CALKINS, professor of philosophy and psychology at Wellesley College, past president of the American Psychological Association and of the American Philosophical Association, died on February 27, in her sixty-seventh year. Dr. Calkins had been associated since 1888 with Wellesley College, where she established one of the first laboratories of psychology.

DR. JOSEPH M. HIRSH, formerly teacher of chemistry at Cooper Union, New York City, who is said to have discovered the process for the recovery of sugar from beet-roots, died on February 13 at the age of eighty-seven years.

DR. JOHANNES GOVERTUS DE MAN, of Yerseke, Holland, died at Middelburg on January 19, at the age of seventy-nine years. He was a foremost carcinologist and had published several hundred valuable contributions on Crustacea. He was formerly conservator of the Rijks Museum of Natural History of Leyden, officer of the Order of Oranje-Nassau and officer of the Order of Cambodje.

MEMORIALS

MRS. PRINCE has given $15,000 for the building and endowment fund of the Boston Medical Library as a memorial to the late Dr. Morton Prince.

A MEMORIAL plaque to the late Sir William Glyn-Jones, formerly secretary of the Pharmaceutical Society of Great Britain, who died on September 9, 1927, was unveiled in the society's examination hall by the Right Honorable Christopher Addison on February 5.

TRIBUTE to the memory of the French mathematician, Pierre de Fermat, is to be paid by the French Academy of Sciences, whose members have ordered his bust to be placed between two other great mathematicians of his period, Descartes and Pascal.

SCIENTIFIC EVENTS

AGRICULTURE IN ENGLAND

AN investigation into the present state of English agriculture has been completed by the Institute of Agricultural Economics of the University of Oxford.

The London *Times* states that the report of the investigation, which has just been issued, points out that

> over a large part of the country considerable difficulty will be experienced in finding any farm to be let, and, moreover, when one is to become vacant, there are perhaps dozens of applications for it. Even the moderately intelligent observer can scarcely fail to ask himself the reason. Is it probable that only the best farms come into the market? That is scarcely credible, because the good farms are too rare to be lightly vacated. Is it only the poorer and more inconvenient, in fact the marginal farms, which are changing hands, and, if so, is it to be supposed that there are so many men, men who have been born to the land and know of its present difficulties, who are anxious to plunge themselves and their families into financial perdition?
>
> What is true beyond all question, is that in some parts of England there is not a farm to be let, and only by offering him a figure in excess of market prices can the tenant be persuaded to give up his holding—he credits a large amount of his assets to good-will. It is equally true that in other parts of England there are farms being carried on by the owners for want of any tenant, farms which have been offered rent free for two and three years without success, and still no working farmers will come forward to invest their capital in them. In other words, although our national agriculture can not be considered prosperous, yet, at the same time, to affirm its general depression is both unwise and untrue. The problem is essentially one of districts, of types of farm and types of farming. For the purposes of the inquiry it was deemed that the course of farm rents, combined with a consideration of the demand for farms or the difficulty of obtaining tenants, in this district or that, would show for England what the rural land market might show in another country.

From the information thus obtained it is declared by the report that depression can not be said to exist in the west, and, conversely, the returns from the eastern parts of the country show the hardships under which the farming community is laboring. English agriculture is not suffering from one simple disease, and there is no one simple remedy which can be applied. The report concludes that:

(1) Some commodities, such as milk and market garden stuffs, are produced, owing to their highly perishable nature, under naturally protected conditions. Where advantage is taken of this natural protection farmers find themselves on a substantial basis of prosperity. Further, where immediate proximity to a consuming center makes it possible to combine production with direct retailing the farmer is peculiarly fortunate, and the complaint is less of depressed agriculture than of depressed industry and the consequent contracted purchasing power of the consumer.

(2) Other commodities, such as corn and meat, enjoy no such natural protection or marketing advantages, but

are produced in direct competition with oversea farmers. This competition is being met successfully: (*a*) by those who tend to conform to the practice of the farmers in the New World, by an extensification of methods, taking little more from the land than nature gives, and in no way seeking to force production; (*b*) by those who occupy land "good enough to eat," which can be relied upon under almost any conditions to give a full return on the capital and labor expended upon it. It is being met with less success by those on certain types of soil, who are seeking to carry on established systems of farming under economic conditions which to-day leave them no margin on their expenditure.

(3) Apart from commodities, and to a lesser extent, perhaps, of soil types and farming systems, farmers who are able to operate their holdings without recourse to hired labor on any considerable scale are meeting the conditions of the times without difficulty.

THE CHARLES LATHROP PACK FELLOWSHIPS IN FORESTRY

THE Charles Lathrop Pack Forest Education Board, founded by the Charles Lathrop Pack Forestry Trust of Washington, D. C., announces a number of fellowships in forestry for the year 1930–31. The purpose of the fellowships is to encourage men who have shown unusual intellectual and personal qualities to obtain training that will best equip them for future leadership either in the general practice of forestry, in the forest industries, in the teaching of forestry, in forest research or in the development of public forest policy.

The awards will be made to gifted men who demonstrate natural powers of intellectual and personal leadership, and who intend to make forestry their life work. The sum of $10,000 is available the first year. The awards will range from $500 to $2,500, or more in exceptional cases, and will ordinarily be restricted to men of American or Canadian citizenship. No restrictions are made as to age, educational status or practical experience, but great emphasis will be placed on character, intellect, qualities of leadership and similar qualifications.

The administration of these fellowships has been placed in the hands of the Charles Lathrop Pack Forest Education Board, which is composed of the following: *Chairman,* Henry S. Graves, dean, School of Forestry, Yale University; *Secretary,* Ward Shepard, U. S. Forest Service, Washington, D. C.; Samuel T. Dana, dean, School of Forestry and Conservation, University of Michigan; John Foley, purchasing agent, Pennsylvania Railroad, Philadelphia; Arthur Newton Pack, Princeton, New Jersey, director, Charles Lathrop Pack Forestry Trust; E. O. Siecke, director, Texas Forest Service, College Station; Ellwood Wilson, chief forester, Laurentide Division, Canada Power and Paper Corporation, Grande Mere, Quebec; Hugo Winkenwerder, dean, College of Forestry, University of Washington, Seattle; Raphael Zon, director, Lake States Forest Experiment Station, St. Paul, Minnesota.

Application forms and other information can be obtained from the secretary of the Charles Lathrop Pack Forest Education Board, 1214 Sixteenth Street, N. W., Washington, D. C. For the current year the completed applications must be in the hands of the secretary not later than April 15. The awards will be made at the next meeting of the board, which will be held in New York City on May 10.

APPROPRIATIONS FOR GRANTS-IN-AID BY THE NATIONAL RESEARCH COUNCIL

AT meetings of the National Research Council's Committee on Grants-in-Aid, held in December and February, twenty-eight appropriations were made from the special fund recently placed in the hands of the Research Council for the aid of research, chiefly through allotments to individual investigators. This committee is composed of the chairmen of the seven divisions of science and technology of the council, together with the chairman of the council, the treasurer and the permanent secretary. The grants made were as follows:

Margaret Harwood, director, Maria Mitchell Observatory, for the measurement of light of variable stars and the computation of periods of variation; Leonard B. Loeb, associate professor of physics, University of California, for a study of the mechanism of the spark discharge; A. H. Pfund, professor of physics, Johns Hopkins University, for the measurement of radiant energy from Brownian movement; Frank Schlesinger, director, Yale University Observatory, for observation of parallaxes and proper motions of bright stars in the southern hemisphere; Arthur H. Warner, instructor in physics, University of California at Los Angeles, for studies of the photoelectric effect from clean tungsten surfaces.

John B. Whitehead, professor of electrical engineering, Johns Hopkins University, for investigations on the fundamental dielectric properties of insulating oils.

William Lester Gilliland, instructor in chemistry, University of Maine, for studies of the properties of carbon monoxide; Linus Pauling, associate professor of theoretical chemistry, California Institute of Technology, for the determination of the electron distribution in various crystals.

T. Addis, professor of medicine, Stanford University Medical School, for a study of hypertrophy and compensatory hypertrophy with respect to renal disease; C. Sidney Burwell, professor of medicine, and Glenn E. Cullen, professor of biochemistry, Vanderbilt University, for investigations on tissue changes in cardiac edema; L. R. Cerecedo, assistant professor of biochemistry, University of California, for investigations on the purine fraction of the nucleic acid molecule; E. A. Doisy, professor of biochemistry, St. Louis University School of

Medicine, for studies of the ovarian hormone; Harry Goldblatt, associate professor of pathology, Western Reserve University, for study of the growth of malignant tissue in vitro; Yandell Henderson, professor of applied physiology, Yale University, for assistance in his studies of the treatment of pneumonia by inhalation of carbon dioxide; William de B. MacNider, University of North Carolina Medical School, for study of the pharmacology and toxicology of white snake root; William C. Rose, professor of physiological chemistry, University of Illinois, for investigations on the nutritive importance of the amino acids.

E. B. Babcock, professor of genetics, University of California, toward the expenses of a collecting expedition for the study of the taxonomy, cytology and genetics of the genus *Crepis;* R. A. Brink, associate professor of genetics, University of Wisconsin, for investigation of the cytological and genetic bases of semi-sterility in maize; Ralph E. Cleland, associate professor of biology, Goucher College, for cytological and genetical studies of *Oenothera;* George M. Reed, research curator, Brooklyn Botanic Garden, for part of the expense of a trip to Japan for the study of varieties, culture and diseases of the Japanese iris.

Thomas R. Garth, professor of educational psychology, University of Denver, for a study of the incidence of color-blindness among Indians; Melville J. Herskovits, assistant professor of anthropology, Northwestern University, for study of the anthropometry and heredity of the American Negro; Arthur Randolph Kelly, assistant professor of anthropology, University of Illinois, for anthropometrical and morphological studies of the Cherokee Indians; Maurice G. Smith, associate professor and head of the department of anthropology, University of Oklahoma, for a study of the peyote cult among the Indians of Oklahoma; Roland C. Travis, Western Reserve University, for experimental investigation of the speed of reflex and voluntary eye movements.

Division of Anthropology and Psychology of the National Research Council, for part of the expenses of a preliminary study of the development of Negro children (jointly with the Social Science Research Council); Division of Anthropology and Psychology of the National Research Council, for part of the expenses of a conference on culture areas (jointly with the Social Science Research Council); Division of Chemistry and Chemical Technology of the National Research Council, for expenses of Professor Austin M. Patterson, of Antioch College, in connection with a meeting of the International Union of Pure and Applied Chemistry on the Reform of the Nomenclature of Organic Chemistry.

Of these twenty-eight grants, one was for the sum of $2,000, and two were for $1,500 each. Eight grants were made for $1,000 each, nine were for sums between $500 and $1,000, and eight for sums of $500 or less.

VERNON KELLOGG,
Permanent Secretary

THE ATLANTA MEETING OF THE AMERICAN CHEMICAL SOCIETY

CHEMISTRY'S advance in the south will be a dominant theme at the seventy-ninth meeting of the American Chemical Society, which will be held in Atlanta, Georgia, from April 7 to 11. More than 1,500 scientific men from this and other countries will attend. Five hundred papers and addresses will be presented outlining the progress in chemical science.

The opening event will be a session of the council on Monday afternoon, April 7, when plans to meet the expanding activities of the society, now, with more than 17,000 members, the largest professional organization of its kind in the world, will be discussed. The president of the society, Professor William McPherson, of the Ohio State University, will preside.

The most pressing need of organized chemistry, according to Dr. Charles L. Parsons, who will submit his annual report as secretary, is an endowment of several millions of dollars to finance the society's publications. Scientific and industrial research is developing so rapidly that the income of the society is no longer sufficient in itself to record it.

To keep American science and industry abreast of knowledge in chemistry, the society has developed a reporting system, centering at the Ohio State University, which covers the world's entire chemical literature, and the results of which are embodied in a publication called *Chemical Abstracts.* The number of periodicals from which digests are made for American use now exceeds 1,500.

At a general meeting on Tuesday morning, April 8, under the auspices of the Division of Industrial and Engineering Chemistry, which will usher in the scientific sessions, industrial chemical processes as practiced in the south will be featured.

On the same day the Division of Physical and Inorganic Chemistry, headed by Professor W. V. Evans, of Northwestern University, will hold a symposium on "Analytical Chemistry." Among the speakers and their topics are: Professor G. L. Clark, University of Illinois, "X-Ray Analysis"; C. C. Nitchie, the New Jersey Zinc Company, Palmerton, Pennsylvania, "Spectrographic Analysis"; C. W. Mason, Cornell University, "Microscopic Methods"; Professor V. K. LaMer, Columbia University, "Modern Methods of Solutions." Other speakers at this symposium will be Professor H. B. Weiser, director of the department of chemistry, Rice Institute; Professor I. M. Kolthoff, University of Minnesota; Professor N. H. Furman, Princeton University, and Professor H. H. Willard, of the University of Michigan, secretary of the division.

In a public address on Wednesday evening, April

9, closing a day of divisional sessions, Dr. Harrison E. Howe, editor of *Industrial and Engineering Chemistry,* will deliver a public address on "Chemistry Comes South." Another event stressing the development of chemistry in the southern states is a symposium on "The Relation of Cotton to Chemical Industry," to be held by the Division of Chemical Education. Experts from all over the country will take part. Dr. Charles H. Herty, past president of the society, will preside.

Practically all the professional divisions will meet in Atlanta. Public health, the growing alliance of chemistry and medicine, chemical education, nation-wide popular training of women in chemistry, rubber, gas and fuel, sugar, petroleum, cellulose, history, agriculture and food, biology, paint and varnish, and water, sewage and sanitation are among the topics to be discussed.

The Division of Biological Chemistry will hold sessions on the relation of vital processes in health and disease, including nutrition, vitamins, irradiation, endocrinology, proteins, amino acids and enzymes. Graduate and undergraduate students will join with teachers from schools and colleges all over the country in the sessions on chemical education.

Mineral waters will be the chief topic of discussion at the sessions of the Division of Water, Sewage and Sanitation Chemistry. The papers at one session will deal with the application of the Food and Drugs Act to the mineral water business and the distribution of safe and palatable table waters and on the utilization of spring waters at health and pleasure resorts. Papers at another session will take up stream pollution, including the work done by the City of Philadelphia toward the cleaning of the Schuylkill River.

Other meetings include those of divisional officers, Erle M. Billings, of Rochester, New York, presiding, and local section officers, with Dr. G. L. Wendt, of Battelle Memorial Institute, Columbus, Ohio, as chairman.

SCIENTIFIC NOTES AND NEWS

PROFESSOR WILLIAM MORTON WHEELER, of Harvard University, has been made an honorary member of the Société Entomologique de France. Dr. L. O. Howard is the only other honorary member among Americans.

THE doctorate of laws was conferred at the mid-year commencement of the University of Pittsburgh on Dr. Herbert Osborn, research professor of zoology and entomology at the Ohio State University.

DR. HENRY LEFFMANN, professor of chemistry in the Wagner Free Institute and in the Woman's Medical College of Pennsylvania, has been elected an honorary member of the Franklin Institute of the State of Pennsylvania.

FREDERICK E. TURNEAURE, dean of the college of mechanics and engineering of the University of Wisconsin, has been awarded the Henry C. Turner gold medal by the American Concrete Institute "for distinguished service in formulating sound principles of reinforced concrete design." The presentation was made on February 13 at New Orleans.

AT the monthly meeting of the American Geographical Society on February 25 the Charles P. Daly gold medal was presented to Nelson Horatio Darton, of the U. S. Geological Survey. The citation read: "His preparation of the topographic base maps of Arizona and New Mexico on the scale of 1:500,000 proclaim him a worthy follower in the great tradition of the surveys 'west of the hundredth meridian.' With great energy and continuity of purpose he has carried forward researches in the physical geography of our western domain from its northern to southern borders and beyond, laying foundations for the fuller enjoyment of its resources."

DR. HERMAN A. SPOEHR, assistant director in charge of the Coastal Laboratory for botany of the Carnegie Institution of Washington, has been appointed director of the Division of Natural Sciences of the Rockefeller Foundation. He succeeds Dr. Max Mason, recently elected president of the foundation. Dr. Spoehr will take up the work on September 1.

PROFESSOR W. CARL RUFUS, of the department of astronomy of the University of Michigan, has been named acting director of the department and acting director of the university observatories, to fill the place of the late Professor Ralph H. Curtiss. Dr. Rufus has been connected with the university since 1917.

DR. EARL D. BOND, who since 1913 has been medical director and physician-in-chief of the department of mental and nervous diseases of the Pennsylvania Hospital, has been appointed professor of psychiatry in the University of Pennsylvania Medical School and will join the faculty on July 1. Dr. Bond also became medical director of the institute for mental hygiene at the Pennsylvania Hospital when the institution opened its new building on March 1.

DR. HENRICUS J. STANDER, associate professor of obstetrics in the Johns Hopkins Medical School, has been appointed professor of obstetrics and gynecology

in Cornell University and head of these departments in the New York Hospital, effective in September, 1931. Dr. Stander will remain at the Johns Hopkins until that time and will act as adviser in obstetrics and gynecology to the New York Hospital in the development of their woman's clinic as part of the plant of the New York Hospital-Cornell Medical College Association.

DR. GERALD S. SHIBLEY, of Columbia University, has been appointed associate professor of medicine in the school of medicine of Western Reserve University, the appointment to take effect on July 1. Dr. Shibley will occupy a similar position on the staff of Lakeside Hospital.

DR. GEORGE M. PETERSON, who has been connected with the staff of the U. S. Treasury Department for the past two years, has been appointed associate professor of agricultural economics on the Giannini Foundation of Agricultural Economics in the University of California.

DR. BRUCE L. WARWICK, formerly assistant professor of genetics and veterinary science, University of Wisconsin, has succeeded Dr. J. L. Lush as animal husbandman, breeding investigations, of the range animal husbandry division, Experiment Station, Agricultural and Mechanical College of Texas. Dr. Lush has accepted a position at the Iowa State College.

CHARLES A. DOBBEL, assistant professor of mining and metallurgy at Stanford University, was recently appointed engineering assistant to Dr. Ray Lyman Wilbur, Secretary of the Interior.

H. E. FOOTE (Ph.D., Brown, '17), a member of the investigational staff of the Mellon Institute since 1927, has been awarded the industrial fellowship on oxygen by the Gas Industries Company, Pittsburgh, designers and builders of liquid-air oxygen apparatus. The investigation is to be concerned with the extension of the present uses of oxygen, and in particular with the application of cheap oxygen in various industrial processes, including metallurgical operations and organic oxidation reactions.

AT the annual meeting of the Research Board of the Engineering Foundation on February 20, officers for the ensuing year were elected as follows: *Chairman,* H. Hobart Porter; *vice-chairmen,* Otis E. Hovey and G. H. Clevenger; *additional members of the executive committee,* Gano Dunn, George L. Knight; *director and secretary,* Alfred D. Flinn.

DR. WILFRED H. OSGOOD, curator of zoology at Field Museum of Natural History, has gone to London, taking with him a number of specimens obtained by the William V. Kelley-Roosevelts Expedition to Eastern Asia which he will study and compare with type-specimens in the British Museum (Natural History).

AN expedition headed by Dr. and Mrs. Herbert Spencer Dickey will leave New York on March 20 in a renewed attempt to discover the exact source of the Orinoco River in South America and possible archeological remains. The expedition is under the auspices of the Museum of the American Indian, Heye Foundation, of which Dr. Dickey is a staff member.

DR. OLIVER C. LESTER, dean of the graduate school and professor of physics at the University of Colorado, who has visited the laboratories of physics of universities in England, Scotland, Germany, France, Switzerland, Italy and Austria, left Colorado on September 4 and spent some time at the California Institute of Technology and the University of California before sailing for London. Dr. Lester returned to New York on February 15, and will spend the next six weeks visiting laboratories in the eastern part of the United States. He will resume his work at the University of Colorado on March 28.

PROFESSOR W. E. ALLEN, of the Scripps Institution of Oceanography, La Jolla, will cooperate with the United States navy in its research on paint to protect ships against marine growths. He will be present in San Diego each month when conditions of growths are inspected.

DR. HUGH S. TAYLOR, professor of chemistry and chairman of the department of chemistry at Princeton University, and Dr. Wallace R. Brode, assistant professor of chemistry at the Ohio State University, will lecture during the intersession of the University of California from May 19 to June 28. During this session Dr. Wolfgang Panzer, professor of geography at the University of Berlin, will give two courses, one on geography and the other on climatology.

AT the meeting of the American Geographical Society on February 25, Mr. R. H. Sargent, of the U. S. Geological Survey, delivered an address on "Alaskan Glaciers from the Air." Mr. Sargent exhibited and described a selection of the aerial photographs made by the Navy Department in cooperation with the U. S. Geological Survey as part of the government mapping program in Alaska. Of special interest were a series of slides illustrating features of glacier flow.

DR. E. W. BERRY, professor of paleontology in the Johns Hopkins University, delivered an address on "The Origin and Evolution of Plants" before the Washington Academy of Sciences on February 20. This is the third of a number of lectures proposed by the academy on various phases of genesis and devel-

opment or "Origin and Evolution," which eventually, and as revised by the authors, may be assembled in book form.

DR. ALBERT W. HULL, assistant director of the research laboratory of the General Electric Company, lectured before the Franklin Institute, Philadelphia, on February 19 on "Vacuum Tube Research."

PROFESSOR G. W. STEWART, head of the physics department at the State University of Iowa and national president of Sigma Xi, addressed the Iowa State College Chapter of Sigma Xi at Ames on February 17. He spoke on "The Liquid State of Matter." The following day Dr. Stewart spoke before the graduate school and the physics seminar on "Experiments in X-ray Diffraction."

PROFESSOR S. R. WILLIAMS, of Amherst College, was the guest of the Rosa Club at Wesleyan University on February 25. Following dinner at the Eclectic Fraternity, Professor Williams addressed the club members on "Teaching and Research in the Field of Physics." Other guests included the faculty committee on vocational guidance and all undergraduates who are interested in physics.

ON February 15 Dr. H. T. Barnes, professor of physics in McGill University, delivered a lecture before the Royal Canadian Institute on "Winter Waterways of Canada."

DR. A. LANDÉ, visiting professor from the University of Tübingen at the Ohio State University, gave a lecture at Ohio University, Athens, on February 20 entitled "Recent Advances in Atomic Structure."

A SYMPOSIUM upon "Evolution and Human Life" was held by the Philosophical Union of the University of California at Los Angeles on February 28. Papers were presented by Dr. J. Arthur Thomson, of the University of Aberdeen, who will be one of the principal speakers at the formal dedication of the new campus and buildings of the university on March 27 and 28; by Dr. Thomas Hunt Morgan, of the California Institute of Technology, and by Dr. Herbert Wildon Carr, who has been a member of the faculty of the University of London.

THE fifteenth annual meeting of the American Association of Petroleum Geologists will be held at New Orleans, Louisiana, from March 20 to 22. The Roosevelt Hotel is headquarters for the convention. Arrangements are in charge of the executive committee composed of the five elected officers of the association, with the cooperation of the New Orleans Convention and Publicity Bureau, Inc., and the management of the Roosevelt Hotel. Nearly a hundred papers are being offered for the program, so that concurrent sessions will be necessary, the several different phases of geological science as applied to the petroleum industry being separated for special sessions in separate rooms. The membership now numbers 2,300. Geophysicists and paleontologists will also have special programs at this convention, the latter group being organized as an affiliated society of the American Association of Petroleum Geologists and known as the Society of Economic Paleontologists and Mineralogists, of which the officers are: *President,* Marcus A. Hanna, Houston, Texas; *Vice-president,* John B. Reeside, Jr., Washington, D. C.; *Past-president,* R. C. Moore, Lawrence, Kansas; *Secretary-Treasurer,* F. B. Plummer, Austin, Texas, and *Editor,* Joseph A. Cushman, Sharon, Massachusetts.

THE laboratory of animal nutrition at Cornell University has recently moved into new quarters provided at the cost of $30,000. Facilities are provided for the study of the fundamental phases of nutrition in both its chemical and physiological aspects. The work of the laboratory is being developed under the direction of Dr. L. A. Maynard and Dr. C. M. McCay.

DISCUSSION

THE ETIOLOGY OF THE DISEASE PSITTACOSIS

THE recent outbreak of human disease associated with disease in parrots resembled in its clinical aspects the disease psittacosis. The etiology of this disease has been in doubt, largely because of the failure to find an agent common to all or most of the cases examined and in the associated ill parrots.

Our investigations were started about January 15. We obtained material from a series of cases and in none were we able to find any evidence that infection by the *B. psittacosis* existed. A sick parrot in a family where there were two ill adults was the only instance where both sources of material were available for laboratory study. The parrot died and an emulsion of the organs fed and injected into another parrot reproduced the same disease picture. The organs of this parrot were emulsified and filtered through a Berkefeld V filter. This when inoculated produced the same disease picture. The materials from this parrot, filtered in the same way, again produced the disease.

The sputum and blood from one of the cases mentioned above were fed to a parrot and a disease picture resulted resembling that of the parrot which presumably infected this case. The organs of the inoculated parrot were used to infect another parrot, after the material had been filtered through a Berkefeld V filter. The disease was again produced. The

material from the second parrot, again filtered, caused the disease and death in a third parrot.

These observations indicate that from the original parrot and also from the human contact we obtained a filtrable virus and that this virus is the primary etiological agent of the disease.

This virus will kill mice whether the material be filtered or not. The virulence for mice does not seem very great, as a few mice survive.

There is an inherent source of error in observations of this character, *viz.*, the danger of "picking up" a virus in the experimental animals used. This possibility has been excluded as far as possible by using parrots from sources free of disease and parrots which had been imported sometime before the appearance of the disease.

As this preliminary note was being prepared a short report in the *Lancet,* February 1, 1930, of the work of Bedson, Western and Simpson came to our attention. They, likewise, believe that they have demonstrated a filtrable virus in parrots. They do not report a similar demonstration in the case of human materials.

We also have caused the death of a parrot with emulsions of the organs of a fatal human case, but filtration experiments on this presumed virus are not completed.

Our observations and those of the English investigators seem for the first time to offer definite indications as to the etiology of the disease psittacosis.

CHARLES KRUMWIEDE
MARY MCGRATH
CAROLYN OLDENBUSCH

BUREAU OF LABORATORIES,
DEPARTMENT OF HEALTH,
NEW YORK CITY

BACTERIUM GRANULOSIS AND TRACHOMA OF AN URBAN WHITE POPULATION

IN a recent issue of SCIENCE[1] a brief note has been published extending the original publication of Noguchi on *Bacterium granulosis* (*nov. spec.*) in relation to the trachoma occurring among the Indians in New Mexico and Arizona. The present report has for its purpose to record the isolation of *Bacterium granulosis* from cases of trachoma occurring in New York City and further experiments on contact infection.

Through the kindness and cooperation of Dr. Martin Cohen, we obtained specimens removed for curative purposes from two patients who had suffered from trachoma two and ten years, respectively. In both patients the pannus and scar-formation, characteristic sequels of the trachomatous disease, were present.

The specimens were employed in the preparation of cultures according to the original Noguchi methods, and from both bacteria were isolated which conformed in all biological properties with *Bacterium granulosis* as obtained from cases of Indian trachoma. Moreover, when the cultures obtained from the New York cases of trachoma were inoculated into monkeys by the Noguchi method, they gave rise in from seven to thirty-three days to the granular conjunctival condition characteristic of experimental trachoma and resembling closely trachoma in man.

Tyler[2] had found that when monkeys in which the the experimental granular, trachomatous lesions are present and normal monkeys with smooth conjunctivae are caged together, the previously healthy animals acquire the experimental disease. Noguchi had previously observed the extension of the lesions from the inoculated to the uninoculated eyes of *Macacus rhesus* and chimpanzees. This presumable contact infection was shown by Tyler's experiments to be possible between inoculated and uninoculated animals.

We have since found that when the secretions from monkeys with the granular lesions are taken on cotton swabs and transferred directly, by rubbing, to the eyes of normal *Macacus rhesus,* the experimental trachomatous disease is promptly produced. In addition, it has been found that when cultures of *Bacterium granulosis* are instilled into the conjunctival sac of normal monkeys and the eyelids gently massaged, infection also occurs and the granular lesions appear quite as early (thirteen days) as after subconjunctical injection.

PETER K. OLITSKY,
JOSEPH R. TYLER

THE LABORATORIES OF THE
ROCKEFELLER INSTITUTE FOR
MEDICAL RESEARCH,
NEW YORK, N. Y.

ACCUMULATION OF GAS IN CLOSED COLLODION SACS IMMERSED IN FLOWING TAP WATER

IN SCIENCE for September 20, 1929, there appeared an article by Stacy R. Guild with the title given above. The essential experimental fact reported is that when a closed collodion sac containing water or an aqueous solution is immersed in running water under some circumstances a bubble of air will be slowly formed within the sac, and grow at a rate proportional to its own surface, while at other times a bubble already present will dwindle away. The experiments suggest

[1] E. B. Tilden and J. R. Tyler, SCIENCE, 71: 186, 1930.

[2] J. R. Tyler, SCIENCE, 70: 612, 1929.

strongly that the controlling factor is the amount of air dissolved in the water; when this amount is known to be large, the bubble grows, and when the water has been degassed before use, the bubble shrinks. Guild appeals to physical chemists to "determine the laws governing this phenomenon and to work out the true explanation of it."

We think that the phenomenon is much less obscure than Guild supposes. In fact, his own experiments are extensive enough to show that there are no very obscure factors operating. It is merely necessary to suppose that a collodion membrane is permeable to air. Tap water is commonly saturated with air at a pressure greater than atmospheric; that is, the partial vapor pressure of the dissolved air is greater than one atmosphere. Then if the membrane is permeable to air (that is, nitrogen, oxygen, etc.) air will pass through until the water on both sides contains air at the same partial pressure. But if this partial pressure is greater than the mechanical pressure on the water, which is, of course, one atmosphere, then the system is unstable, air will be evolved more or less rapidly and a bubble will form. Once the bubble is started, the rate of growth will be proportional to the interface, that is, to the surface of the bubble. When we have the bubble in the sac and flow degassed water past it, the same processes occur in the reverse direction. The water inside the sac is saturated with air at a pressure greater than that outside, so that air is lost to the running water and the bubble shrinks.

P. L. K. GROSS

DEPARTMENT OF CHEMISTRY
POMONA COLLEGE

LOUIS S. KASSEL
National Research Fellow in Chemistry
CALIFORNIA UNIVERSITY

HISTORY OF THE DISCOVERY OF PERIODIC REVERSAL OF HEART-BEAT IN INSECTS

SUPPLEMENTARY NOTE

IN a recent paper[1] I have traced the early history of the discovery of periodic reversal of peristalsis of the heart in Lepidoptera, a phenomenon which accompanies metamorphosis and continues to the end of life, resembling in certain respects a similar phenomenon in ascidians. Periodic reversal in Lepidoptera, discovered by Malpighi in 1669, expressly denied in the first half of the nineteenth century by such excellent observers as Herold (1823) and Verloren (1844), confirmed for the chrysalis (silkworm) by Cornalia (1856), was first adequately described by Bataillon (1893, 1894).

In writing this historical review I was unaware of the second paper on the subject by Bataillon,[2] in which he extended his observations to the adult silk-moth and found, as I have done recently, that periodic reversal in the direction of the heart-beat is not a temporary phenomenon connected with metamorphosis but, in confirmation of Malpighi's observations, is characteristic of the adult moth. I will here briefly summarize and translate Bataillon's later conclusions.

He states that, having regarded the phenomenon as connected with disturbances in nutrition during metamorphosis, he had been skeptical of Malpighi's observations on the adult, especially in view of the fact that they were made on the eviscerated insect under obviously abnormal conditions. Continuing he says:

> If the dorsal integument is carefully shaved and the median line smeared with glycerine to make it more transparent, the heart becomes visible, and its movements can be observed until death. Here, again, in spite of the defects of his technique, Malpighi was right. The circulation takes place sometimes in one direction, sometimes in the other.

On the basis of experiments upon full-grown larvae, he concluded that pupation and periodic reversal of circulation in the dorsal vessel depend upon three factors which presumably reduce internal pressure, *viz.*, elimination of the contents of the intestine, transpiration and spinning.

Of the adult insect he says:

> There are, at first, successive periods of direct or of reversed circulation every one or two minutes; then these periods are longer, especially while the individuals are in copulation. Finally, the contractions of the dorsal vessel succeed each other regularly and alternately, from in front backward and from behind forward, becoming less and less marked at the approach of immobility and death.

Thus he calls attention to the comparatively short periods of forward and backward peristalsis in the young moth, to the longer phases sometimes induced by copulation and to the reduction of the successive alternating phases in old age to single beats, observations similar to those which I have made.[3]

Hypodermic injection of saline solution (sea-water) into the blood of the adult moth caused an immediate cessation of reversal; forward beating alone occurred for several hours. The employment of suction, on the other hand, was followed by long periods of backward beating. By the injection of air into the hemolymph, the forward flow of the blood

[1] J. H. Gerould, *Biol. Bull.*, 56 (3): 215–225, 1929.

[2] E. Bataillon, "Nouvelles recherches sur les mécanismes de l'évolution chez le Bombyx mori," *Revue bourguignonne de l'enseignement supérieur*, 4: 1–16, 1894.

[3] J. H. Gerould, "Periodic Reversal of Heart Action in the Silkworm Moth and Pupa," *Jour. Morph. and Physiol.*, 48: 385–430, 1929.

was enormously stimulated and became even tumultuous; this was seen in marked degree in old individuals which were decrepit and motionless. Such a moth, for example, injected in the morning, immediately was thrown into a state of intense activity which continued during the rest of the day, followed by death a few hours later.

In conclusion Bataillon says:

> The entire life of *Bombyx* from the spinning to death presents constant physiological characteristics: lowering of internal pressure; respiratory and circulatory disturbances, and histolysis. . . . The circulatory disturbances . . . are merely the permanent index of more profound disruptive changes.

Both Bataillon in his earlier paper (1893)[4] and Fischer (1918)[5] suggested that periodic reversal may be due to increased acidity of the blood accompanying metamorphosis. This idea is supported by a recent paper in Japanese by Yokoyama[6] who has succeeded in bringing about periodic reversal prematurely in the larva by blocking the abdominal spiracles with enamel paint or by injecting into the hemolymph of the abdomen (at the eighth abdominal segment) weak solutions of lactic or acetic acid.

JOHN H. GEROULD
DARTMOUTH COLLEGE

THE CHEMICAL CONSTITUTION OF PECTINATELLA

IN searching for material in order to study the synthesis of protein, Pectinatella was examined. The thought was that here was a source of rapidly formed gelatin, or its precursor collagen. A mass weighing from 2 to 5 kilos is formed within a few weeks, comparable to the growth of certain tumors. The fact that investigation reveals that the jelly-like secretion is not of the nature of collagen but of true protein of a fairly high order does not rob the study of its interest or importance, for the organism stands as a readily available source of study of extremely rapid synthesis of protein.

The material was supplied by Professor Raymond C. Osburn, director of the Stone Laboratory, Put-in-Bay, Ohio. Pectinatella is available in large quantities during the summer and autumn. It may be preserved in fresh water, and sampling is possible from the growth, the remainder proceeding with its growth without detriment.

The water content is high. A specimen weighing 1,200 grams gave, on drying, 5.0 grams dry weight. Protein, etc., therefore make up about 0.5 per cent. of the normal body.

The protein reactions were typical of such proteins as ovalbumin, serum albumin, etc. The biuret reaction was positive and typical, that is, like that of white of egg and not like that of gelatin or peptone.

The following amino-acids were demonstrated: tyrosin, tryptophane, cystin. In a cold extract of the dried material all three were positive, but the reactions were intensified after acid hydrolysis. This was especially true of cystin. The protein was heat coagulable.

Of the inorganic substances, sodium chloride was demonstrable. Phosphorus was negative before hydrolysis, and after boiling with equal volumes of sulphuric and nitric acids, none was demonstrable. Calcium is present in copious amounts, as one would suspect from the calcareous nature of the body and statoblasts.

Characteristic of these organisms is the supporting structure composed of chitin. In the specimens examined chemically, glucosamine (galactosamine?) was readily demonstrable after hydrolysis. This amino-sugar has extensive distribution through the animal kingdom and in man occurs in cartilage.

WITHROW MORSE
JEFFERSON MEDICAL COLLEGE,
JANUARY 3, 1930

REPORTS

THE TEACHING OF HYDROBIOLOGY AND AQUICULTURE IN AMERICAN UNIVERSITIES

THE committee on aquiculture of the Division of Biology of the National Research Council has had a subcommittee engaged in gathering data on the teaching of hydrobiology and aquiculture in American universities. This committee has consisted of James G. Needham, A. G. Huntsman, Chancey Juday and E. N. Transeau. A report has recently been submitted, embodying the following data.

Sixteen institutions in the United States and Canada give courses in these subjects. These institutions and their undergraduate courses are listed in the accompanying table. These courses are called by various names, as indicated in the footnotes to the table.

[4] E. Bataillon, *Bull. Sci. France et Belgique*, 25: 18–55, 1893.

[5] E. Fischer, "Eine bei Raupen und Puppen beobachtete Umkehrung der peristaltischen Herzbewegung," *Entom. Rundschau. Stuttgart*, 35: 9–10, 1918.

[6] T. Yokoyama, "Notes on the Periodic Reversal of Heart-beat in the Silkworm *Bombyx mori* L.," *Dobutsugaku Zachi (Zool. Mag.)*, 39, No. 459, Suppl.: 45–51, 1927.

SUMMARY OF INSTRUCTION IN HYDROBIOLOGY AND AQUICULTURE IN NORTH AMERICAN UNIVERSITIES, 1929

Institution	Staff	Limn.*	Aqc.**	Ichthyology	Dis.***
1. Cornell	P P P I	3	3	6	
2. Illinois	P P P	3			v
3. Indiana	P I	5+			
4. Iowa	P				
5. Kansas	P	3			
6. Maryland	P	v		v	
7. Michigan	P P P P I	5+4‡		2‡	4+
8. Montana	P	?			
9. N. Carolina	P	5			
10. Queens	P	4	4		
11. Rutgers	P P P P	3			3
12. Stanford	P P P	3†			
13. Toronto	P P	3			
14. W. Virginia	P P	2†			v
15. Washington	P P P P I	5+5	5-5	5	5
16. Wisconsin	L	2+2			

Under Staff, P = professor, I = instructor, L = lecturer, conducting the course listed. In other columns, numerals indicate credit hours in courses; v = variable.

* Limnology or hydrobiology or fresh-water biology.

** Aquiculture or fish culture.

*** Diseases of fishes or fish parasites.

† Limnology directed toward public health rather than toward aquiculture.

‡ Repeated in summer at the biological field station of the university.

Owing to the newness of the subject of instruction they are very diverse also in content and in emphasis. So great is this diversity that a blank designed to gather data proved to be of little use. It merely developed these facts not shown in the table:

1. That these are upperclass courses.

2. That from one to three courses in zoology are the usual prerequisites; less often, courses in botany, ecology and entomology.

3. That the study of plankton and systematic determinations of invertebrate animals still receive chief emphasis.

4. That a little quantitative work is done in very different subjects.

5. That a rather high proportion of field work during the portion of the year favorable to it is the rule.

6. That emphasis on marine biology goes with proximity to the sea.

Our table seems to show a considerable staff of men engaged in teaching the subjects listed, but as a matter of fact nearly all these men do this work incidentally to other heavier duties. They do it voluntarily in addition to the other teaching or administrative work that is required of them. Aside from the staff of College of Fisheries of the University of Washington (where the emphasis is on marine biology) there appear to be but three men commissioned to devote themselves wholly to fresh-water work: Dr. Juday to limnology at Wisconsin, Dr. Embody to aquiculture at Cornell and Mr. W. J. K. Harkness at Toronto. Dr. Embody's course in aquiculture has been running since 1912.

Courses in ichthyology and parasitology are included in this table only for those institutions that offer also the other subjects; they are here included because they are important contributory training for hydrobiology. There are courses in all universities that provide training in the fundamental sciences.

There are other bits of related work omitted, such as the plankton work that is done at the University of Colorado in a course on bacteriology for civil engineers, and parts of courses in ecology, zoology, parasitology and microbiology given in a number of institutions, notably in Illinois, Ohio and Toronto.

The two Canadian institutions listed have representatives on the Biological Board of Canada and participate in its summer field work. The department of biology of the University of Toronto provides certain offices for the board and maintains a special laboratory for fresh-water investigation, the Ontario Fisheries Research Laboratory.

JAMES G. NEEDHAM, *Chairman*
CORNELL UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MICROCINEMATOGRAPHIC APPARATUS FOR THE OWNER OF A 16-MM MOTION PICTURE CAMERA

THE usefulness of motion pictures for teaching and demonstration of scientific facts has been established long ago; this is especially true in the microscopic field, where phenomena are to be demonstrated before an audience. A microscopic demonstration becomes impractical when the audience is of any size.

It is therefore a great satisfaction to have the experiment "stowed away" in the form of a motion picture film to be ready for projection whenever and wherever needed.

To make motion picture records of microscopic objects, if one has the necessary microcinema equipment, is not difficult at all. An apparatus designed for this purpose has been described in SCIENCE[1] and in the *Transactions* of the Society of Motion Picture Engineers.[2] It is a standard equipment for modern laboratories doing microscopical investigations. This apparatus, however, requires the use of standard motion picture film of 35 mm width (professional size).

In order to enable the owner of a 16-mm motion picture camera (amateur size) to make microscopic film records without difficulties and great expense, an apparatus (Figs. 1 and 2) has been devised whereby

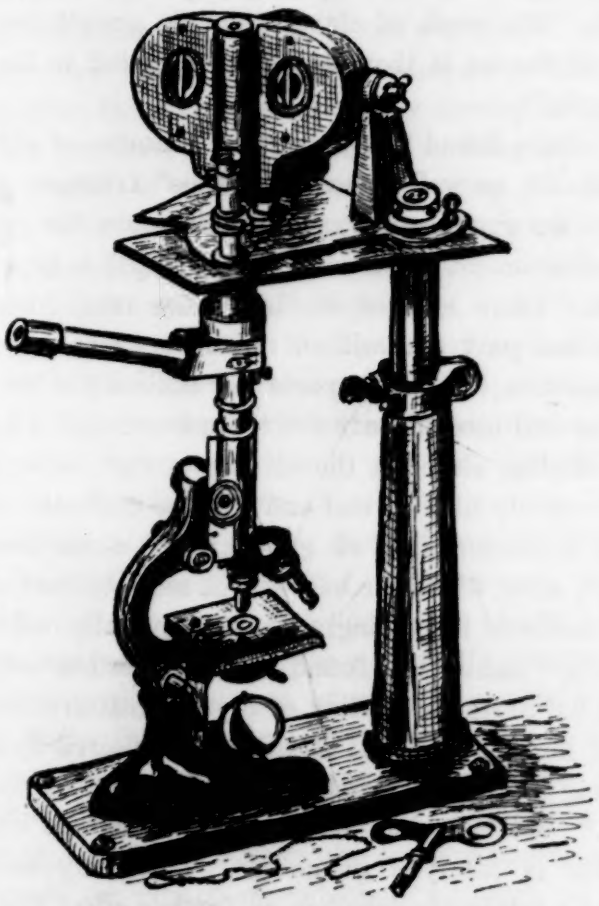

FIG. 1. Microcinema Apparatus with Filmo 70 (Bell and Howell Company), driven by spring motor, adjustable speed up to 128 exposures per second.

any 16-mm camera, be it either Filmo, Ciné Kodak, Victor Ciné Camera, etc., can be used. The apparatus is constructed upon the same principles as the large machine although more simplified and smaller in size, the actual dimensions being 22 x 14 x 9 inches.

The instrument consists of a cast-iron base plate with sleeve, a steel column, a fixed and a swivel plate with focusing and beam centering device. All parts are machined, turned and polished and assembled with great care and precision, so that serious work can be done with it.

The microscope, of any make, is placed on the base

[1] 69: 672, June 28, 1929.
[2] 13: 461–464, 1929.

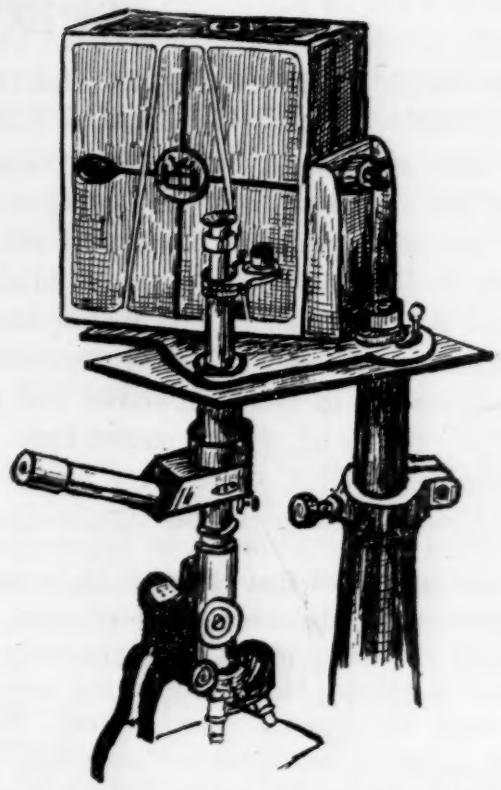

FIG. 2. Microcinema Apparatus with Ciné Kodak Model A, hand driven. Attachments are available for "slow motion" and "time lapse."

plate and brought in line with the focusing device. When the object is sharply in focus it is also automatically in focus on the film in the camera, and the film record can be taken immediately by swinging the camera into position over the microscope and releasing the spring motor or turning the crank of the camera.

A beam splitter with observation tube can be employed when it is desired to observe the specimen while it is being photographed.

As a light source any projection lamp from 50 to 200 watt is more than sufficient when ordinary bright field pictures are to be taken. For taking pictures with dark field illumination (indirect illumination) a small arc lamp of the ordinary type (about 4, 5 ampere) is recommended.

Pictures of small objects, for instance, insects, etc., may be easily taken, by removing the microscope and using a small lens attachment which can be screwed onto the fixed plate.

Another attachment can be substituted whereby single exposures at certain predetermined time intervals can be made. This device consists of an electric timer which controls the camera and also the light source. This arrangement is for the purpose of making accelerated motion pictures for the study of slowly moving objects, for instance, living tissue cells, the growth of bacteria, etc.

HEINZ ROSENBERGER
THE ROCKEFELLER INSTITUTE FOR
MEDICAL RESEARCH

SPECIAL ARTICLES

"AUXIMONES" AND THE STIMULATION OF LEMNA BY ORGANIC MATTER

SOME time after the discovery that vitamins were necessary for the growth and well-being of animals, a claim was put forward by Bottomley and Mockeridge that similar substances were essential for the growth of green plants. These investigators found that Lemna (duckweed) failed to grow and reproduce continuously in two well-known salt solutions, but that if extracts of organic matter from peat, soil or manure were added, satisfactory results were obtained. From their experiments they concluded

> It is now established that plants, in their turn, require growth-promoting substances, or auximones; which in the case of the lower plants, are apparently manufactured by themselves, but which in the case of green plants, must be supplied from without. Since these necessary accessory substances are essentially organic in nature, their only possible source in the case of ordinary green plants is to be found in the organic matter of the soil in which they are growing.[1]

My attention was drawn to the work of Bottomley when I was studying the reproduction of yeast in synthetic media at Toronto. I found that it was possible to grow yeast without the addition of any organic matter except sugar, although reproduction was always better when particular organic extracts were added. Fulmer, however, proved conclusively that these "Bios"-containing extracts were stimulants and not essentials. It occurred to me that similar results might be obtained with green plants if they were grown in suitable inorganic solutions.

Some time later at Iowa State College I had the opportunity of going more fully into the auximone theory. It was necessary first to find an inorganic medium in which the Lemna would reproduce without the addition of organic matter. To this end Mr. Roller and I set out systematically to test salt solutions containing the essential elements; eventually we obtained an inorganic medium in which Lemna major reproduced and remained healthy without any added organic matter.[2] This showed that there are no *essential* organic substances needed for the green plant in the same way that vitamins are necessary for animals. I investigated shortly afterwards the pH required by the plants and the effects of duration and intensity of light.[3] In all cases the medium was made from carefully purified salts and special care was taken to have distilled water free from contamination. Recently Ashby, in London, has used this medium for the growth of Lemna minor and has confirmed our conclusions.[4]

These results, however, still left open the question of stimulation of green plants by organic matter. Mockeridge found stimulation with soil and manure extracts, even with an inorganic medium unsuited to the Lemna—the greater the degree of decomposition of the manure, the more stimulation was found. The theory was therefore put forward by Mockeridge that bacteria produce the substances which stimulate the plant: "The work of elaborating the growth-promoting substances is therefore thus relegated to the soil bacteria."[5]

We have found that extracts of manure, of soil and of alfalfa, as well as various "Bios" fractions which affect the growth of yeast, will increase the rate of reproduction of the Lemna when the pH is kept constant. There is a rapid rise in the rate, from less than one part per million of the organic matter in the solution, up to ten parts per million for the particular soil used, twenty for the manure and sixty for the alfalfa, although the alfalfa extract did not behave exactly like the soil and manure extracts. There is a maximum rate of growth over a considerable range, after which the addition of more extract makes the medium increasingly toxic, especially with the alfalfa. Ashby has found that stimulation occurred with 0.2 parts per million of organic matter extracted from horse dung, that it was not impaired by autoclaving and that the ash did not increase the growth rate.[6] He considers that the action of the organic matter is catalytic in nature, "since any addition above a minimum dose has no further effect upon the growth rate."

In these experiments great care was taken to keep the plants as free as possible from contamination with micro-organisms. Ashby, in his later experiments, sterilized his solution and changed it every forty-eight hours—in some of my experiments I changed every twelve hours.[2] It seemed to me, however, that there was always the possibility of a symbiotic relationship between the Lemna and bacteria in which the latter would make use of the organic matter. In order to do away with this possibility it was necessary not only to grow the plants in a sterile solution, but also to free them entirely from bacteria—a much more

[1] Mockeridge, *Biochem. Jour.*, 14: 432, 1920.
[2] Clark and Roller, *Soil Sci.*, 17: 193, 1924.
[3] Clark, *Jour. Phys. Chem.*, 29: 935, 1925; *Plant Physiol.*, 1: 273, 1926.
[4] Ashby *et al.*, *Ann. Bot.*, 42: 771, 1928.
[5] Mockeridge, *Ann. Bot.*, 38: 723, 1924.
[6] Ashby, *Ann. Bot.*, 43: 805, 1929.

difficult operation. It was to this problem that Mr. Roller turned his attention last winter.

Hansteen in 1898 had reported an attempt to sterilize Lemna by washing—testing for bacteria by the effect on egg albumen. We were quite unable to free the plants of bacteria by this method—whatever the effect on the albumen, some bacteria always grew on a nutrient agar. This would be expected, and we found in later experiments that plants which were bacteria free on the surface—no growth showing for five or six days on agar—when macerated, produced colonies abundantly.

In his sterilization experiments Mr. Roller tried ultra-violet light and a large number of antiseptics at various concentrations, and finally developed a technique which killed the micro-organisms both inside and outside the plant—no growth is developed on any medium yet tried for the bacteria whether the plant is macerated or not. We have grown the sterile Lemna through some twenty-five to fifty generations in the inorganic solution and they are reproducing normally and continue to look healthy. The first unexpected result was that the rate of reproduction of the sterile plants was greater than that of the non-sterile plants in the sterilized inorganic medium.

A second unexpected result was that the addition of sterile organic extracts of soil and manure (optimum concentrations) to the sterile inorganic medium with the sterile plants resulted in a decreased rate of reproduction compared with the sterile checks in the purely inorganic medium; the non-sterile plants, with the same sterile additions of organic matter, reproduced faster than the non-sterile plants in the sterilized inorganic solution—a confirmation of the work we have mentioned above, and as Ashby has also reported. Without bacteria the organic matter seems to depress the rate of reproduction, although we have not yet found whether this is due to a variation in the optimum concentration of the organic matter under the sterile conditions.

At the same time cultures were run in which the sterile plants had added to them, both in the sterilized inorganic solution and in the sterilized solution with organic extracts, an infusion of live bacteria from soil. The inorganic solution with the bacteria tended to decrease the rate of reproduction of the Lemna; where the organic matter was present the rate was greater than in the same solution without the bacteria, but it did not altogether overcome the original depression caused by the organic matter—the rate was distinctly lower than the checks for the sterile plants in the sterile inorganic medium.

In the sterile medium with sterile plants we have so far failed to get stimulation of the rate of reproduction of the Lemna by adding sterile organic extracts which certainly increase the rate when the plants are non-sterile. Details of this work with the effects on dry weight and ash will be reported later after some of the debatable points are examined further, but the present state of the problem is distinctly interesting.

NORMAN ASHWELL CLARK
DEPARTMENT OF CHEMISTRY,
IOWA STATE COLLEGE

OCCURRENCE OF GERMANIUM AND ARSENIC IN METEORITES[1]

THE only record of a non-terrestrial occurrence of germanium is due to Rowland[2] who obtained spectroscopic evidence of this element in the reversing layer of the sun. Investigations carried on in this laboratory established the fact that germanium is of wide distribution in so far as the earth's crust is concerned.[3] On deciding to extend these investigations to meteorites, six specimens were selected representing siderites, siderolites and aerolites. The specimens were subjected to arc spectral excitation by a method described elsewhere,[4] and the spectrograms were examined in the range between λλ 3040 and 2530 angstroms. In all cases the germanium lines λλ 2651.6 and 2651.1 were definitely, though faintly, visible. These lines are extremely helpful in recognizing germanium: in addition to their being highly persistent they lie in a range where the dispersion of the prism spectrograph is considerable, thus minimizing difficulties due to overlapping of lines, especially when specimens of complex composition are examined.

On the basis of these observations it is to be concluded that traces of germanium are present in the following meteorites:

1. Siderite from Toluca, Mexico.
2. Siderite from Welland, Ontario. (Fell 6: 30 A. M., December 14, 1807.)
3. Siderolite from Admire, Lyon County, Kansas.
4. Siderolite from Llano del Inca, Atacama, Chile. (Found in 1888.)

[1] Presented at the forty-third meeting of the American Astronomical Society, Harvard College Observatory, January 1, 1930. The investigation upon which this announcement is based was supported by a grant to S. L. Boothroyd and Jacob Papish from the Heckscher Foundation for the Advancement of Research, established by August Heckscher at Cornell University.

[2] Rowland, *Amer. Jour. Sci.*, 41: 243, 1891.

[3] See Papish, *Econ. Geol.*, 23: 660, 1928; 24: 470, 1929. Additional work is ready for publication.

[4] See Papish, Brewer and Holt, *Jour. Amer. Chem. Soc.*, 49: 3028, 1927.

5. Aerolite from Estacado, Crosby County, Texas.
6. Aerolite from Allagan, Allagan County, Michigan. (Fell July 10, 1899.)

The two siderites, of which the writers possessed a comparatively large quantity, were subjected to chemical treatment for the purpose of extracting germanium from them. The procedure was as follows.

Twenty-six grams of the Toluca siderite and sixteen grams of the Welland siderite were introduced into separate Pyrex distilling flasks connected to water-cooled condensers and provided with glass receivers cooled with ice. An excess of hydrochloric acid was added to the meteorites through dropping funnels. The reaction, which was violent, was allowed to proceed to completion. The solutions in the flasks were kept boiling till each was reduced to about one half of its initial volume. In this manner the germanium in the soluble portion was afforded an opportunity to form the tetrachloride, which is a fuming liquid boiling at 86° C., and as such to condense in the cooled receiver together with a preponderating amount of hydrochloric acid. The distillates were next saturated with hydrogen sulphide and allowed to stand several days. The precipitated sulphides were collected on small filter papers; the papers and contents were placed in porcelain crucibles and treated with nitric acid. The excess of acid was driven off with the aid of heat, and the viscous residues were examined spectrographically for the presence of germanium. The results were gratifying. The residue obtained from the Toluca meteorite yielded a spectrum which contained the following germanium lines: λλ 3039.1, 2754.6, 2709.6, 2691.3, 2651.6, 2651.1, 2644.2, 2592.5 and 2533. The more persistent of these lines, namely, λλ 3039.1, 2651.6 and 2651.1, were also visible in the spectrum of the Welland meteorite, though their intensity was much lower. This decrease in number and intensity of the spectral lines is to be ascribed to the fact that the quantity of germanium extracted from the Welland meteorite was smaller than that extracted from the Toluca meteorite.

The controversial views expressed by Merrill[5] regarding the presence of arsenic in meteorites made it desirable to look for this element in the two siderites. When the siderites were dissolved in hydrochloric acid and the solutions distilled for the extraction of germanium, it was anticipated that arsenic, if present, would also distil over, as the trichloride. Accordingly, when the distillates were saturated with hydrogen sulphide and the resulting precipitates oxidized with nitric acid, the excess of acid, as already stated, was driven off till *viscous* residues were obtained. It was feared that if the residues were taken down to dryness, or ignited, the arsenic, if present, would be expelled. The spectrograms of these residues contained the arsenic line λ 2780.2. An additional spectrographic examination in the more refrangible range revealed the presence of the following lines also due to arsenic: λλ 2349.8 and 2288.1.

To obviate errors that might result from use of reagents and apparatus, "blank" tests were made as follows. A volume of hydrochloric acid equal to that used in connection with the siderites but somewhat more dilute was distilled in a manner similar to that already described. As a matter of fact, in one case the apparatus employed for this purpose was the same that was used in the work on the Toluca siderite. The distillate was saturated with hydrogen sulphide. As usual a slight opalescence, undoubtedly due to precipitated sulphur, made its appearance. Since there was not enough of this precipitate to be retained by a filter paper, a few milligrams of copper sulphate dissolved in a minute quantity of water were added. The copper sulphate was found on previous examinations to be free from germanium and arsenic, at least in quantities detectable spectroscopically. The precipitated copper sulphide is an ideal adsorbent for traces of other sulphides. The solid material thus obtained was removed by filtration, oxidized with nitric acid as before and examined spectrographically. No lines of germanium or arsenic were observed.

[5] Merrill, *Memoirs Nat. Acad. Sci.*, Vol. 14, 1st Memoir, p. 8, 1925.

SUMMARY

1. Spectroscopic evidence has been obtained of the occurrence of germanium in certain siderites, siderolites and aerolites.
2. Judging from the number and intensity of spectral lines the germanium in these meteorites is present in traces.
3. Germanium has been extracted from Toluca and Welland siderites.
4. Arsenic has been extracted from Toluca and Welland siderites.

JACOB PAPISH
ZAIDA M. HANFORD

DEPARTMENT OF CHEMISTRY,
CORNELL UNIVERSITY

BOOKS RECEIVED

GRAHAM, MICHAEL. *The Victoria Nyanza and its Fisheries.* 64 illustrations. 55 tables. Pp. 255. Waterlow and Sons, London. 10/-.

HOBBS, WILLIAM H. *The North Pole of the Winds.* Pp. viii + 376. 24 illustrations. Putnam's. $5.00.

MERRIAM, JOHN C. *The Living Past.* Pp. xi + 144. 15 plates. Scribner's. $2.00.

STRANG, RUTH. *An Introduction to Child Study.* Pp. xii + 550. Illustrated. Macmillan. $2.75.